Impacts of QX disease on the population and habitat structure of Sydney rock oysters, *Saccostrea glomerata* (Gould), in the Hawkesbury River, NSW, Australia

Stephen Summerhayes

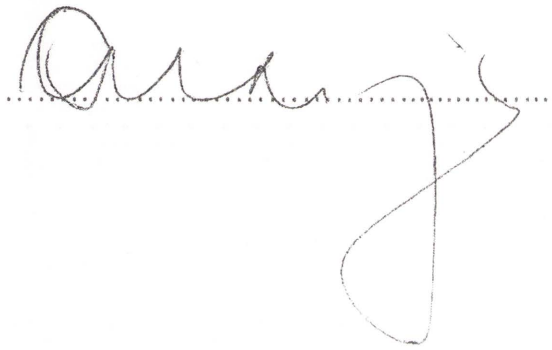
Thesis submitted for the Master of Science (Research) degree
University of Technology, Sydney

December 2008

Certificate of authorship/originality

I, Stephen Summerhayes, certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of the requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.



Acknowledgements

I was attracted to marine research by my supervisors, Brendan Kelaher and Melanie Bishop. I had the good fortune to be taught by them and was captivated by their intimate knowledge of marine systems and experimental design and analysis.

Later, during my undergraduate studies, I was seduced by the breathtaking beauty, historical tapestry and dynamic ecological complexity of the Hawkesbury River. I leaped at the opportunity to research this system, encouraged by Kenneth Brown, a teacher whom I admired, coupled with the promise of supervision by Brendan and Mel. In-field experience with Ross McPherson and his team, estuary managers, heightened my attraction and fortified my will.

Brendan acted as supervisor for the first half of my research. Mel then took the reins, later in concert with Andrea Leigh. When my attentions were diverted by the myriad of interesting research elements, I could rely on my supervisors to focus my thoughts. Requests for assistance and guidance were immediately and gleefully actioned. Mel was indefatigable and carried the weight of my not inconsiderable demands for information. Thanks.

Ready to learn and discover, I bounded into the field. One of the attractions of the Hawkesbury River is its unpredictability, especially to the uninitiated. It can transform from a tranquil, peaceful waterway into a tempestuous force with a magnitude that reinforces its dominance. My friend, Cybele Shorter, was omnipresent and ensured I didn't front the challenge alone. She taught me rivercraft, boatcraft and enlightened me to the pleasures, dangers and nuances of the estuary. Without her, my research would have ebbed like the tide.

The oyster farmers, Rob Moxon, John Stubbs and Bruce Alford, were keen to support research and, in the process, elucidate the mysteries that had befallen their industry. Like life-long friends they welcomed me with open arms, offering time, equipment and expertise. When sampling alone in the field, I was secure in the knowledge that they were nearby - somehow they always knew where I was and what I was doing.

Andrea Leigh offered her armoury of expertise and assumed a supervisory role at another crucial moment in my research. She too is a first class scientist and was keen to link her abundant experience. She added support and insight that only a caring, independent, knowledgeable mind can.

The critical time for thesis submission was New Years Eve. Mel and Andy, without question, diverted time from other commitments and Christmas festivities to ensure that it was presented in a timely fashion.

Not to be forgotten are those who assisted in the oft-tiresome elements of sampling, sample processing and sampling unit manufacture, deployment and retrieval. These people are listed in the manuscripts forming chapters 2 and 3, (see the acknowledgements on pages 29 and 54 respectively).

Otherwise, at times, I had to dig my heels in deeper and make good on the silent promises to myself and those that had helped me.

This merit of this research has underpinned an ARC Linkage grant.

Table of contents

List of figures

Chapter 2 Status of wild oyster populations in the Hawkesbury River, NSW, Australia, following QX mortality of cultured oysters

Chapter 3 Effects of oyster death and shell disarticulation on associated communities of epibiota

Appendix 2

List of tables

ABSTRACT

Oysters are ubiquitous and conspicuous components of estuarine systems. They play pivotal structural and functional roles, providing an array of ecosystem services of commercial, biological and social value. In the Hawkesbury River estuary, NSW, Australia, two oyster species co-occur, the endemic Sydney rock oyster, *Saccostrea glomerata*, and the non-native Pacific oyster, *Crassostrea gigas*, a noxious species occupying a small proportion of the estuary's oyster population. In 2004, Queensland Unknown (QX) disease caused by the protozoan parasite, *Martelia sydneyi*, led to catastrophic mortality of cultivated *S. glomerata*. Industry turned to QX-resistant strains, which have produced mixed success, and triploid *C. gigas* which, although successful, produce small numbers of fecund diploid offspring which can release larvae, increasing pressure upon wild natives. If QX similarly impacts wild *S. glomerata*, both death and subsequent shell degradation could alter the facilitation of biodiversity and assist invasion of faster growing Pacific oysters. To identify whether wild *S. glomerata* have experienced similar mortality to aquaculture oysters and to assess changes in invasive *C. gigas* abundance, this research sampled oyster cover, species composition, abundance, size and condition in two key habitats: rocky shore and mangrove, along-estuary. Sampling revealed sizeable populations of live natives dominated by individuals sufficiently large to have survived QX seasons. Abundance differed between habitats but % mortality, size and condition did not, although trends of increasing % mortality and size with distance up-estuary were evident. *C. gigas* abundance was similar to previous estimates. To evaluate effects of oyster habitat degradation on biodiversity, using the natural gradient of % mortality, oysters and epifauna occupying 100% oyster cover were identified and enumerated at sites along-estuary. Epifaunal community structure differed among sites, following an along-estuary gradient correlated with live oyster abundance. To separate effects of mortality and shell degradation from salinity, habitat structural components (live oysters, dead and degraded shell) were manipulated with comparisons against sandstone oyster mimics. Treatments containing a component of half shells (greater interstitial spaces and surface area) supported greatest epibiota abundance. Matrices comprised solely of live oysters supported fewest species and numbers of organisms, perhaps due to filter feeding depleting resources. Oyster analogues supported similar diversity to natural assemblages, but could not replicate community composition. This study assists in understanding the nature and magnitude of impacts on wild oyster populations subsequent to a major aquaculture disease event. It also illustrates the effects of oyster mortality upon associated biodiversity, exemplifying the need to maintain live oyster populations to preserve unique biotic assemblages. The biological and ecological functions of oysters render this information crucial to the preservation of the extensive ecosystem services provided by estuaries and oysters.